Meeting the DER Goal with Turbines

Peer Review of the Microturbine and Industrial Gas Turbine Programs

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Fairfax VA

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The "Grid" is No Longer Assumed

- Transition to competitive energy marketplace underway
- National concerns over grid reliability and security are well established
- Facilities seeking control of power supply
- A diverse set of DG solutions emerging
  - Reciprocating engines and combustion turbines
  - Microturbines
  - Renewables and Fuel cells

What are Distributed Energy Resources?

- General agreement that DER is close to load,under 50 MW, and most of output used by host facility
- Includes
  - CHP
  - Backup power
  - Niche applications such as premium power, peak shaving, and green power

What's the DER Market Opportunity?

- Facilities use DER to generate power on-site in lieu of grid purchases to cut costs and boost reliability
- Currently, US manufacturers ship over $3 billion in DER worldwide
- Rough market estimates based on emergence of improved DER units call for $5-10 billion annually in US markets alone (equipment and installation)
- Service market could be substantial at $1-2 billion annually

Currently, DER Around 13 GW

- 1999 installed DER capacity is estimated at 13 GW, based on EIA data for non renewable operating units under 50 MW
- Does not include backup units, which add about 18 GW
- Does not include renewables, which add about 6-9 GW
- Generally this data agrees with other data points

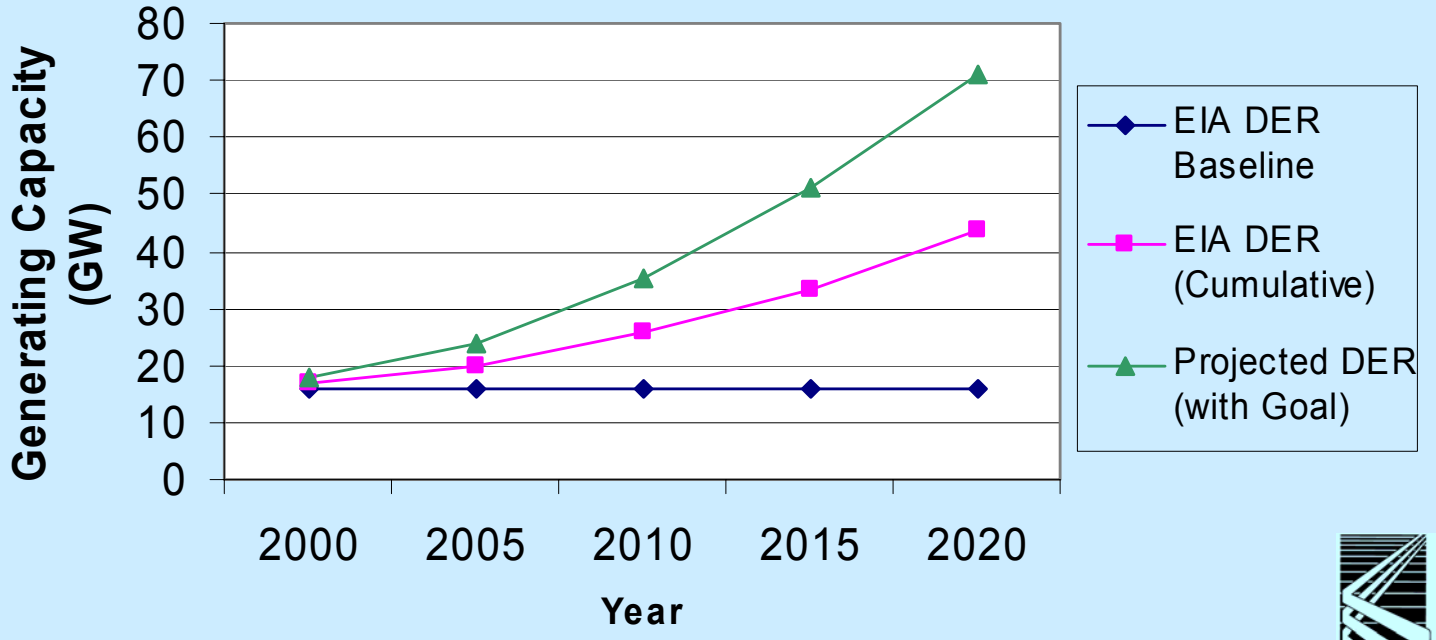
Other Data Points:

Gas Technology Institute (GTI) has 1998 DG capacity (generally under 25 MW) at 28 GW, of which 18 GW is backup units and 10GW is other DG.

Edison Electric Institute (EEI) data from 1997 indicates DG capacity around 10.8 GW for units under 25 MW, and 21.5 GW for units up to 50 MW, including renewables.

What is the DER Goal?

- 20 percent of new capacity added between 1999 and 2020
- EIA estimates and forecasts put new capacity additions at 276 GW
- 20 percent of this means 55 GW of new DER



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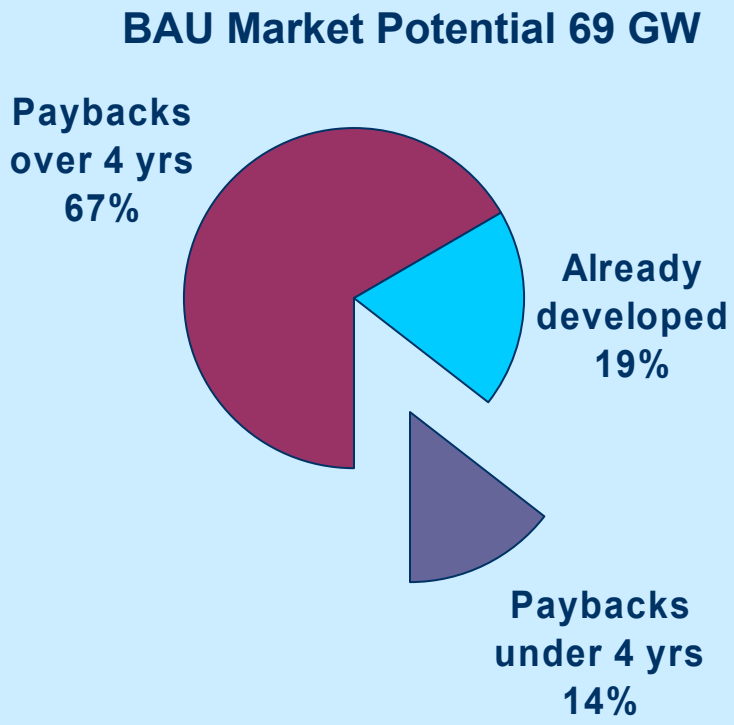
Are We Ready to Meet the Goal?

- Soon to be published studies of CHP for building and industrial applications indicate that business as usual (BAU) market potential is about 69 GW. Includes straight power generation, CHP, and CHP w/absorption cooling.
- Of this potential, about 35 GW have paybacks of four years or less, which is generally required for business to adopt new technology
- With current installed base at 13 GW, only 22 GW economically achievable projects left to meet goal
- DER not economically ready to meet 55 GW goal



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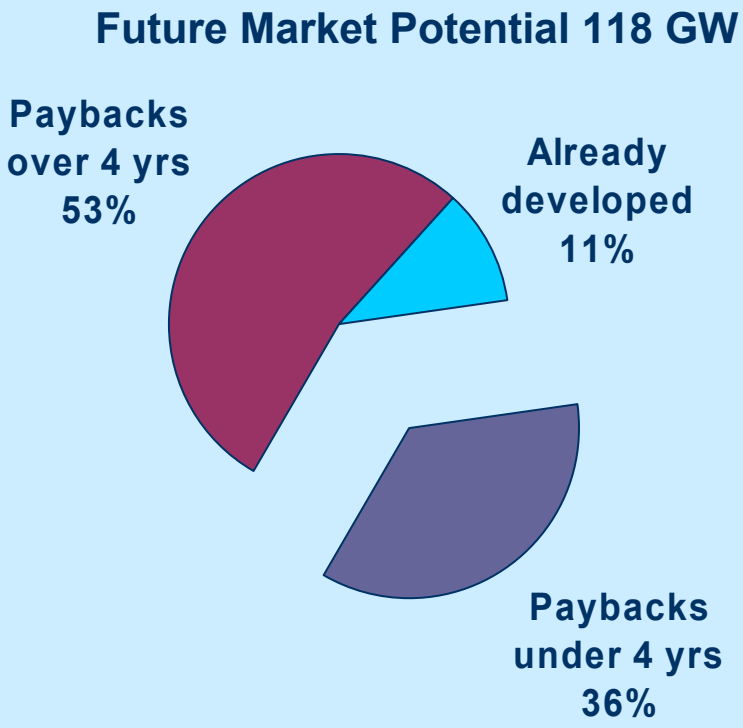
What Will it Take?

- The contractor studies of CHP for industry and buildings indicate that future market potential jumps to 118 GW
- Of this potential, about 73 GW have paybacks of four years or less
- With current installed base at 13 GW, 60 GW of economically achievable projects remains
- Developing future DER units would be enough to meet goal, but barrier removal necessary to ensure broad market penetration



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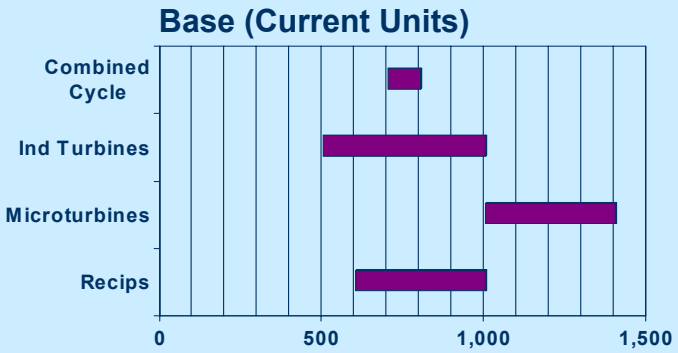
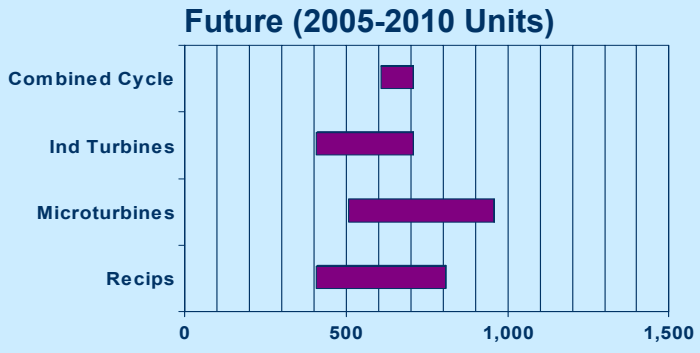
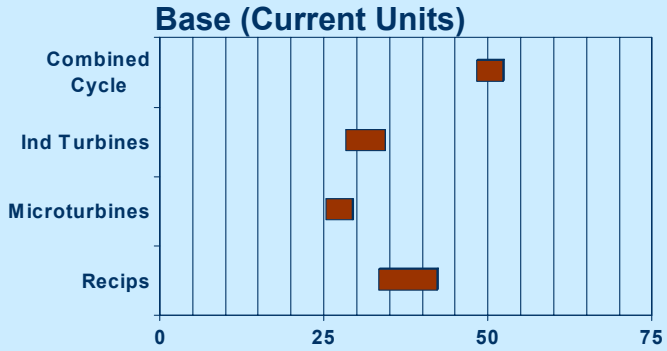
Cost and Performance of All DER Expected to Improve Over Time

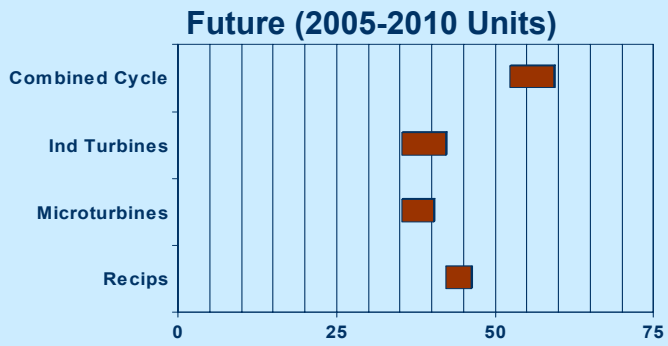
Installed Cost ($/kW)





Electrical Efficiency (%)





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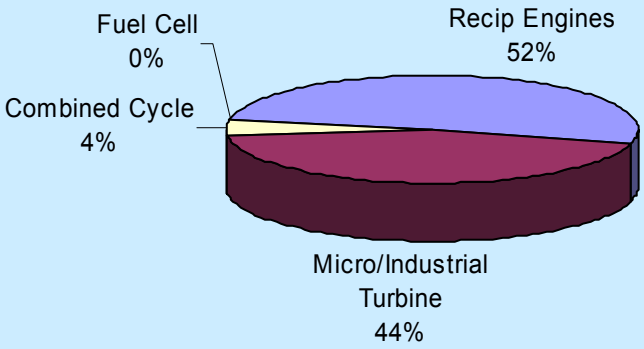
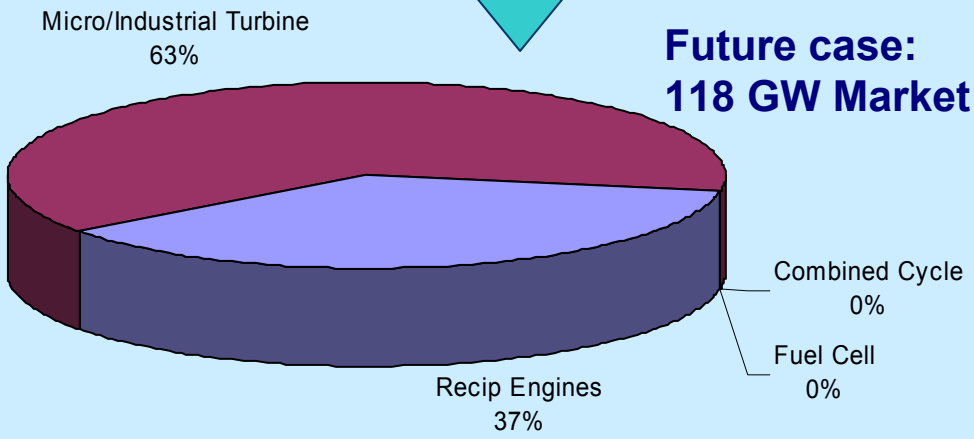
Improving Unit Cost and Performance Expands Market and Turbine Share

Base case:
69 GW Market Potential



Future case:
118 GW Market Potential



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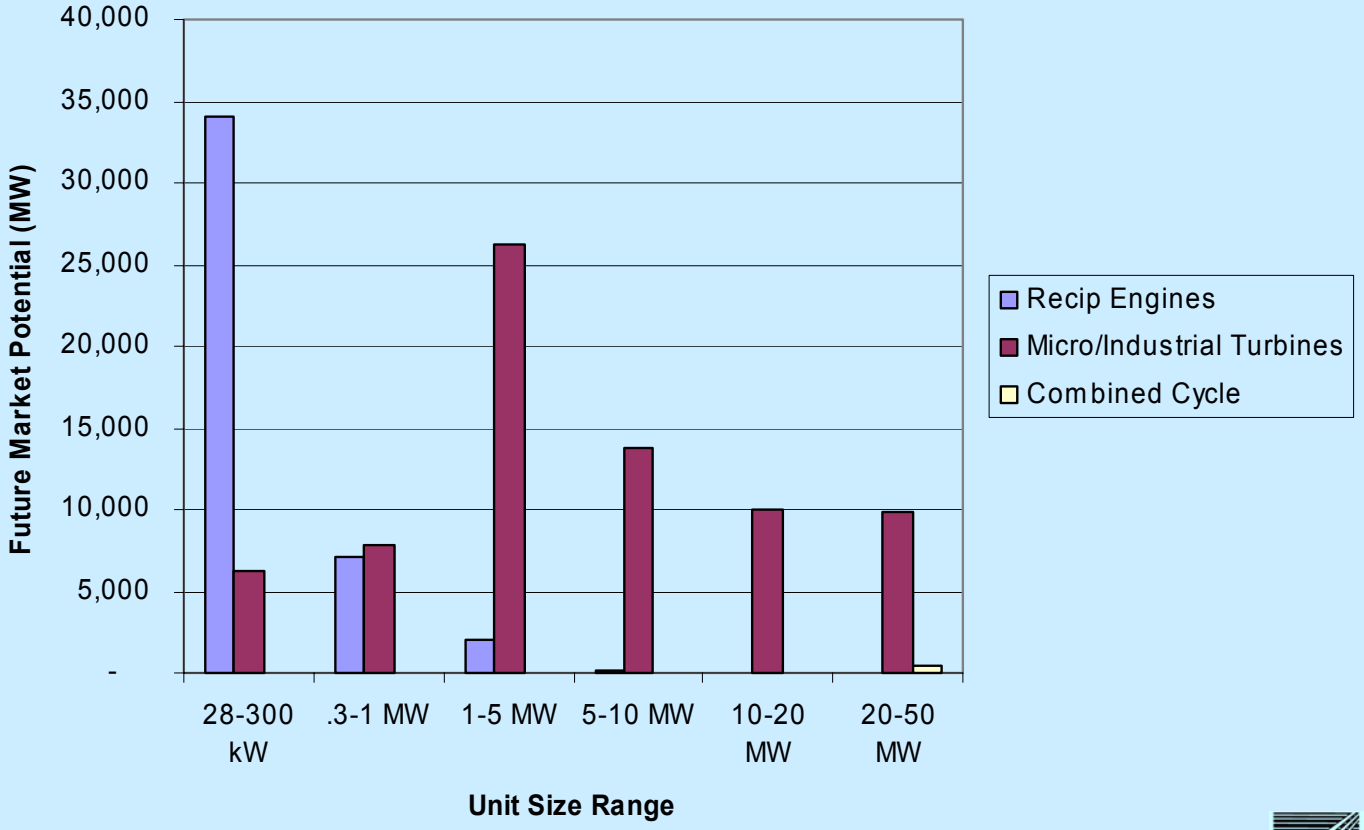
Turbines Offer Potential Across DER Size Range



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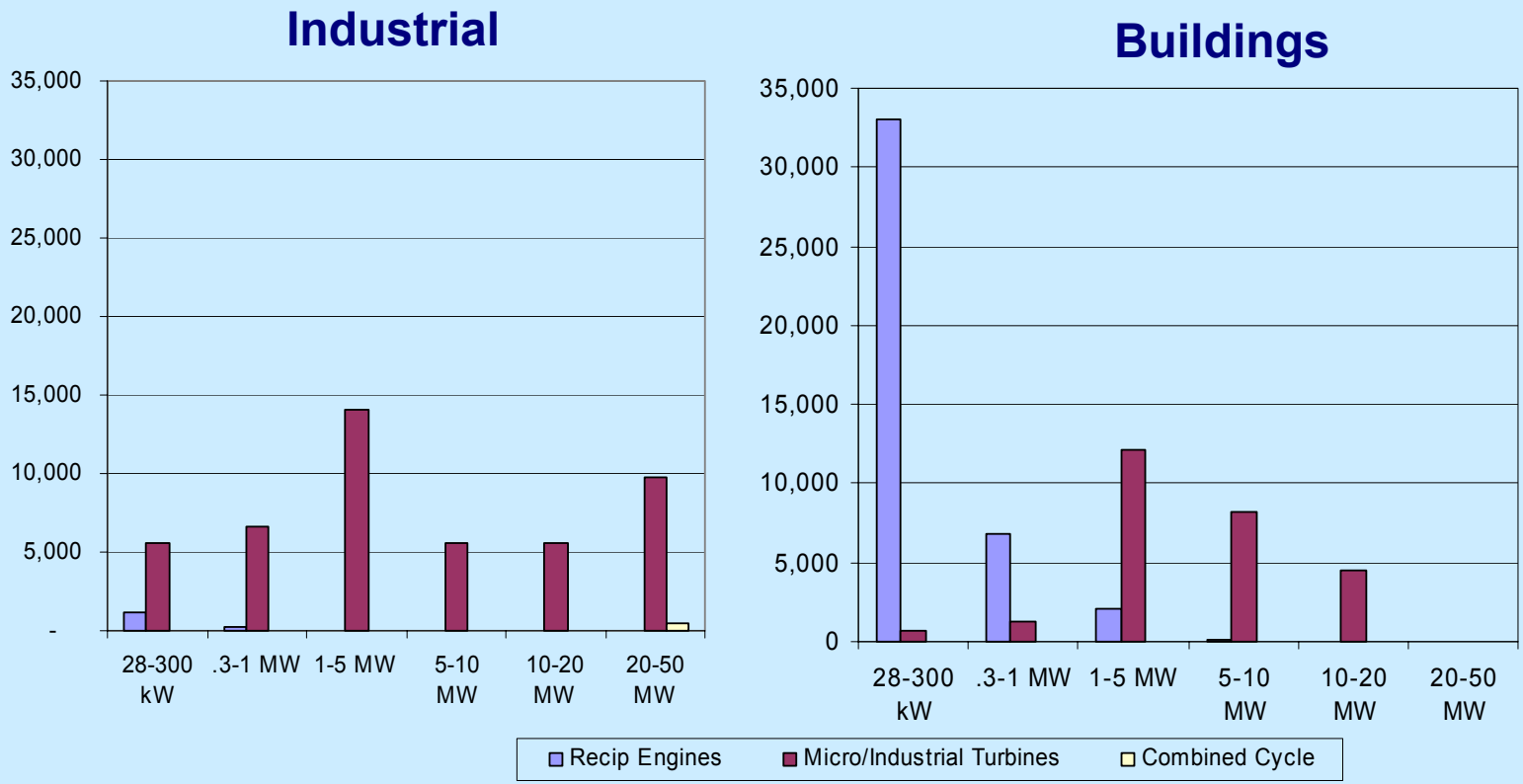
Turbines Potential Throughout Industrial Sector and Large-Sized Buildings



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How to Meet the Goal

- Turbine products need to reach target improvements
- Grid needs to be DER ready
  - Interconnection technology issues resolved
  - Grid/DER interactions must be encouraged
    - Backup power
    - Sales to grid/net metering
    - Transmission and distribution system deferral value
    - Grid-independent operation?
- Market should value non-energy benefits of DER

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